



Shunock River

Watershed Summary

WATERSHED DESCRIPTION AND MAPS

The Shunock River watershed covers an area of approximately 10,590 acres in the southeastern corner of Connecticut (Figure 1). There are several towns located at least partially in the watershed, including the municipalities of North Stonington and Stonington, CT.

The Shunock River watershed includes one segment addressed in this TMDL impaired for recreation due to elevated bacteria levels (CT1004-00_01). This segment was assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. One segment in the watershed is currently unassessed as of the writing of this document. This does not suggest that there are no issues on these segments, but indicates a lack of current data to evaluate the segments as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 (CTDEEP, 2010).

The bacteria impaired segment of the Shunock River (CT1004-00_01) begins at the outlet of Ripley Parks Pond just south of Babcock Road in North Stonington center, flows southeast passing under Route 184, Interstate 95, and Route 49 in North Stonington, and ends at the confluence with the Pawcatuck River in North Stonington just north of the Stonington-North Stonington town line. The segment is 4.37 miles long and is located entirely within the Town of North Stonington.

The impaired segment of the Shunock River has a water quality classification of A. Designated uses include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. This segment of the river is impaired due to elevated bacteria concentrations, affecting the designated use of recreation. As there are no designated beaches in this segment of the Shunock River, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Impaired Segment Facts

Impaired Segment:

Shunock River (CT1004-00_01)

Municipalities: North Stonington

Impaired Segment Length (miles):
4.37

Water Quality Classification:
Class A

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Shunock River, 1004

Regional Basin: Pawcatuck Main Stem

Major Basin: Pawcatuck

Watershed Area (acres): 10,590

MS4 Applicable: No

Figure 1: Watershed location in Connecticut

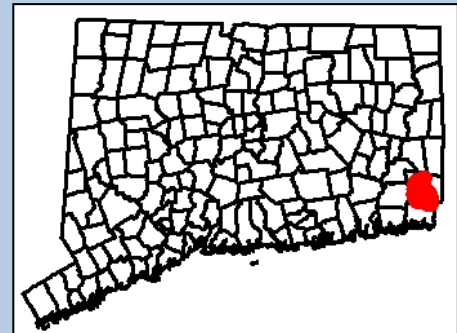
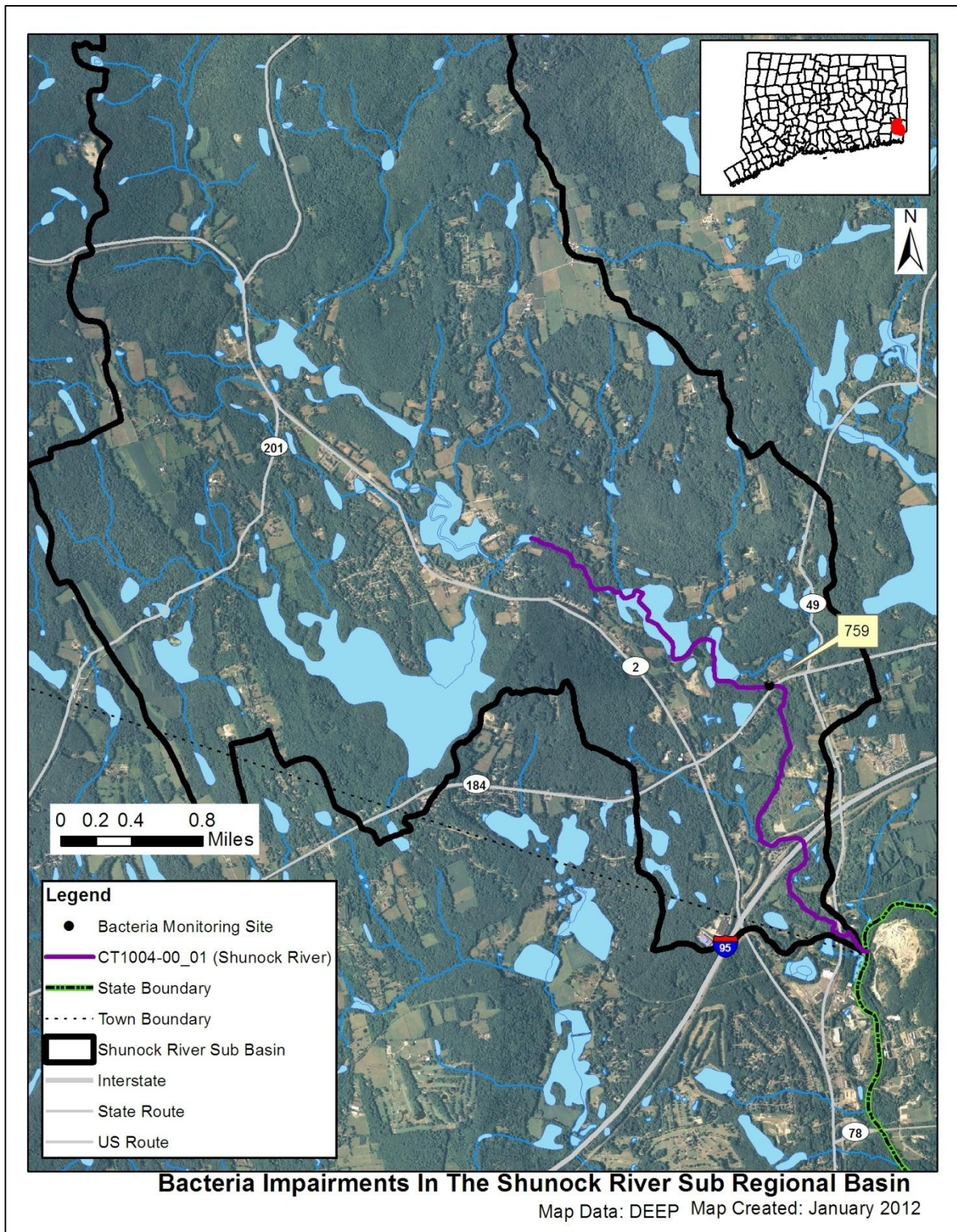


Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

| Waterbody ID | Waterbody Name | Location | Miles | Aquatic Life | Recreation | Fish Consumption |
|--|------------------|---|-------|--------------|------------|------------------|
| CT1004-00_01 | Shunock River-01 | From mouth at Pawcatuck River, US to Side Pond dam at outlet of Ripley Parks Pond (just south of Babcock Road), North Stonington Center. | 4.37 | FULL | NOT | FULL |
| CT1004-00_02 | Shunock River-02 | From inlet to Ripley Parks Pond (just south of Babcock Road), North Stonington center, US to headwaters (above Gallup pond, south side of Route 201). | 3.92 | U | U | FULL |
| Shaded cells indicate impaired segment addressed in this TMDL FULL = Designated Use Fully Supported NOT = Designated Use Not Supported U = Unassessed | | | | | | |

Figure 2: GIS map featuring general information of the Shunock River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Shunock River watershed consists of 15% urban area, 63% forest, 12% agriculture, and 10% water. The majority of the watershed surrounding the impaired segment is a mix of urban, forested, and agricultural land uses. There are several large agricultural areas in the Shunock River watershed adjacent to the Shunock River (Figure 4).

Figure 3: Land use within the Shunock River watershed

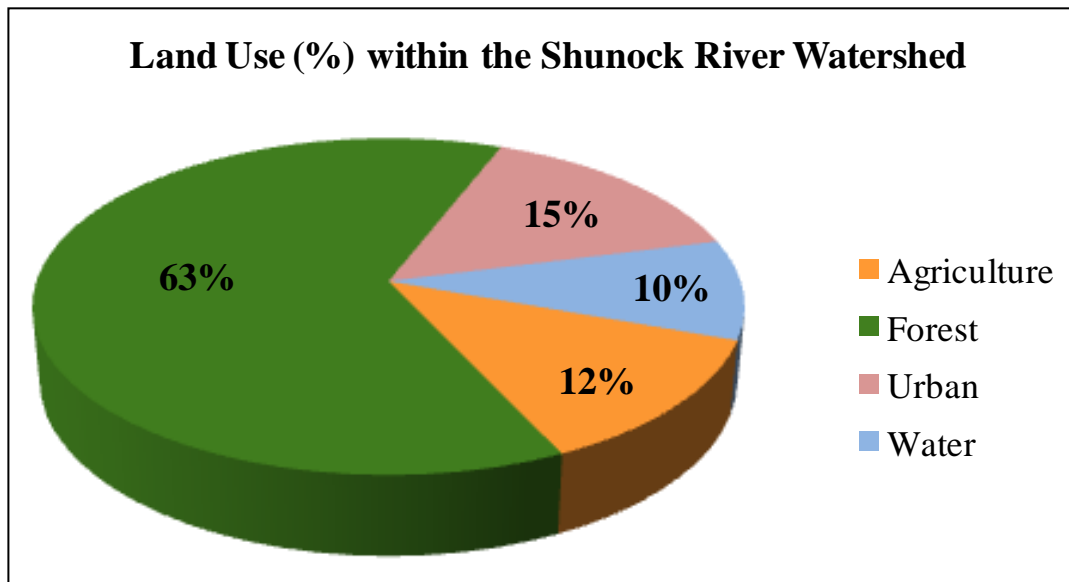
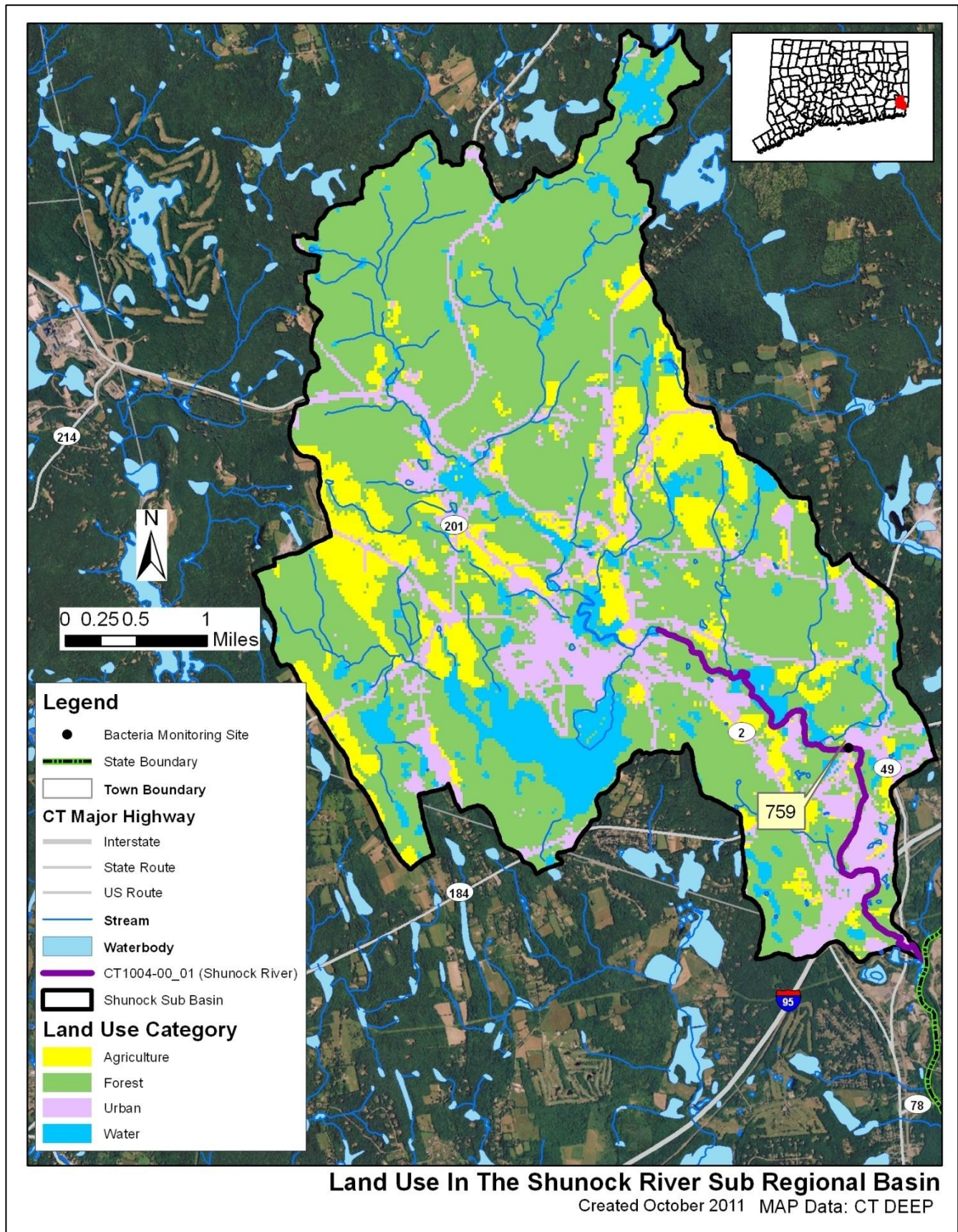


Figure 4: GIS map featuring land use for the Shunock River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired segment of the Shunock River watershed (stations organized downstream to upstream)

| Waterbody ID | Waterbody Name | Station | Station Description | Municipality | Latitude | Longitude |
|--------------|----------------|---------|---------------------|------------------|-----------|------------|
| CT1004-00_01 | Shunock River | 759 | Route 184 | North Stonington | 41.430447 | -71.852558 |

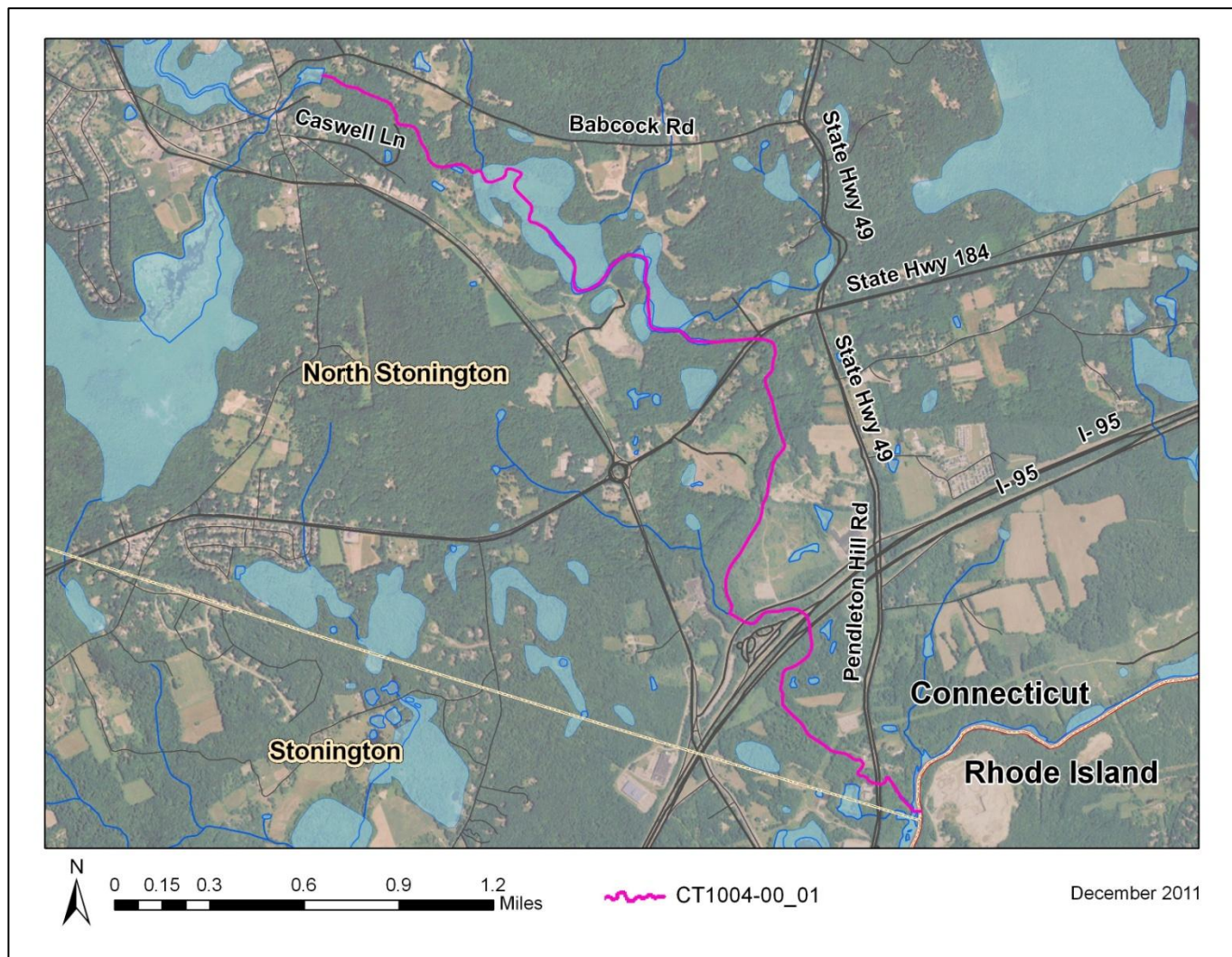
The Shunock River's impaired segment (CT1004-00_01) is a Class A freshwater river (Figure 5). Its applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location, Station 759, from 2006-2009 (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results from 2006-2009, are presented in Table 7. The annual geometric mean was calculated for Station 759 and did not exceed the WQS for *E. coli* in any sample year. Single sample values at this station exceeded the WQS for *E. coli* on two sample dates in 2008.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for Station 759 for wet-weather and dry-weather sampling days, where appropriate (Table 7). The geometric mean during wet and dry-weather did not exceed the WQS for *E. coli* at Station 759. The geometric mean during wet-weather was twice that of dry-weather.

Due to the elevated bacteria measurements presented in Table 7, this segment of the Shunock River did not meet CT's bacteria WQS, was identified as impaired, and was placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the impaired segment of the Shunock River



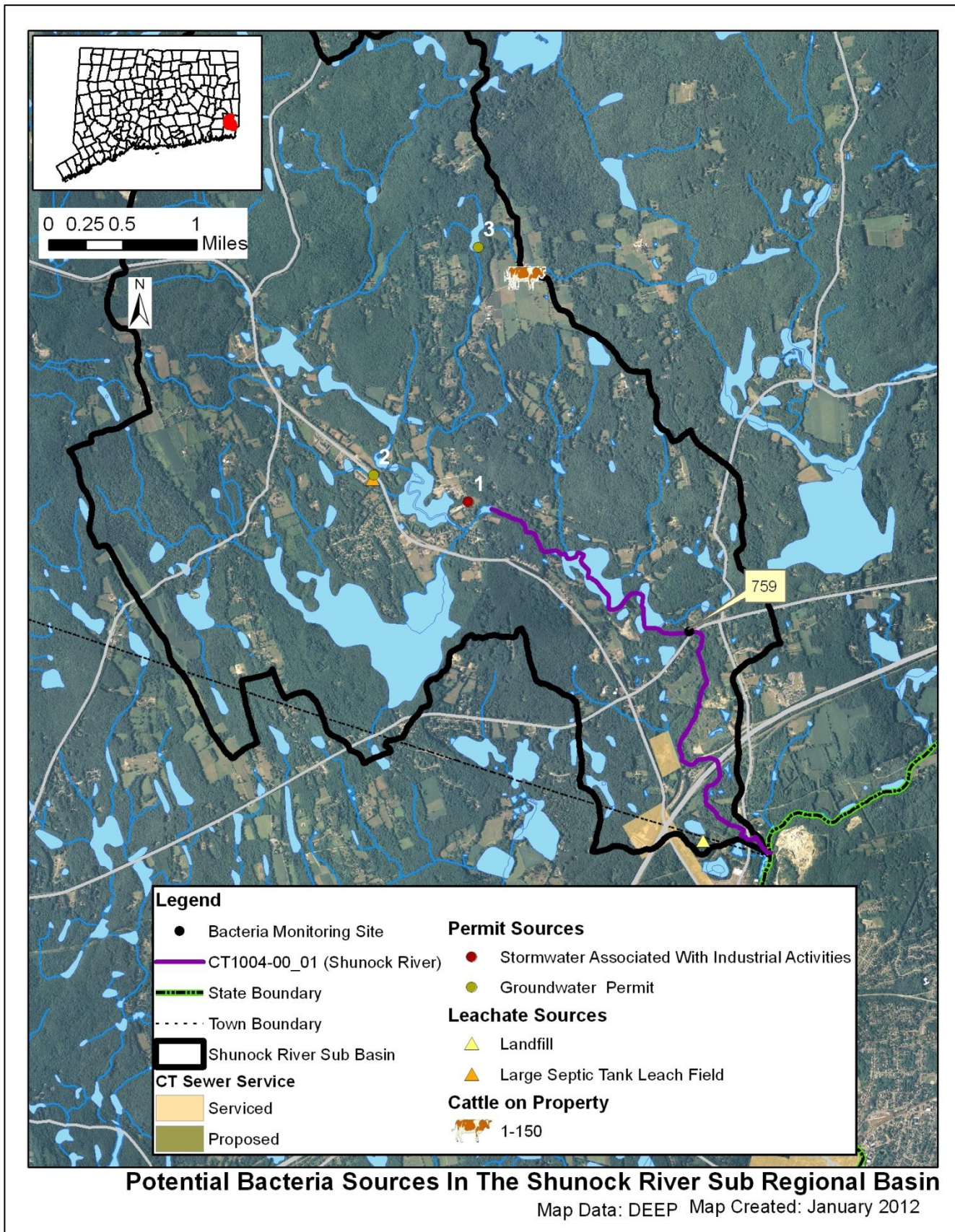
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Shunock River watershed

| Impaired Segment | Permit Source | Illicit Discharge | CSO/SSO Issue | Failing Septic System | Agricultural Activity | Stormwater Runoff | Nuisance Wildlife/Pets | Other |
|-------------------------------|----------------------|--------------------------|----------------------|------------------------------|------------------------------|--------------------------|-------------------------------|--------------|
| Shunock River CT1004-00_01 | x | | | x | x | x | x | x |

Figure 6: Potential sources in the Shunock River watershed at the sub-regional level



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Table 6.

Table 4: General categories list of other permitted discharges

| Permit Code | Permit Description Type | Number in watershed |
|--------------------|--|----------------------------|
| CT | Surface Water Discharges | 0 |
| GPL | Discharge of Swimming Pool Wastewater | 0 |
| GSC | Stormwater Discharge Associated with Commercial Activity | 0 |
| GSI | Stormwater Associated with Industrial Activity | 1 |
| GSM | Part B Municipal Stormwater MS4 | 0 |
| GSN | Stormwater Registration – Construction | 0 |
| LF | Groundwater Permit (Landfill) | 0 |
| UI | Underground Injection | 2 |

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Shunock River watershed. Bacteria data from 2002-2003 from one of these industrial permitted facilities are included in Table 6. Though this data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform bacteria, the Town of North Stonington (GSI001476) exceeded 1,000 colonies/100mL in 2003.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Shunock River watershed

| Town | Client | Permit ID | Permit Type | Site Name | Address | Map # |
|------------------|--------------------------|-----------|--|--------------------------------------|----------------------------------|-------|
| North Stonington | Town Of North Stonington | GSI001476 | Stormwater Associated With Industrial Activities | North Stonington Public Works Garage | 11 Wyassup Road | 1 |
| North Stonington | Esplanade Hilltop, Llc | UI0000346 | Groundwater Permit | Esplanade Hilltop, Llc | 373 Norwich-Westerly Road (Rt 2) | 2 |
| North Stonington | R. J. Properties, Llc | UI0000292 | Groundwater Permit | Bellissimo Grande | 411A Norwich Westerly Road | 3 |

Table 6: Industrial permits in the Shunock River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

| Town | Location | Permit Number | Receiving Water | Sample Location | Sample Date | Result |
|------------------|--------------------------|---------------|-----------------|-----------------|-------------|--------|
| North Stonington | Town of North Stonington | GSI1476 | Shunock River | 1 | 08/29/02 | 3 |
| North Stonington | Town of North Stonington | GSI1476 | Shunock River | 1 | 06/18/03 | 1,700 |

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

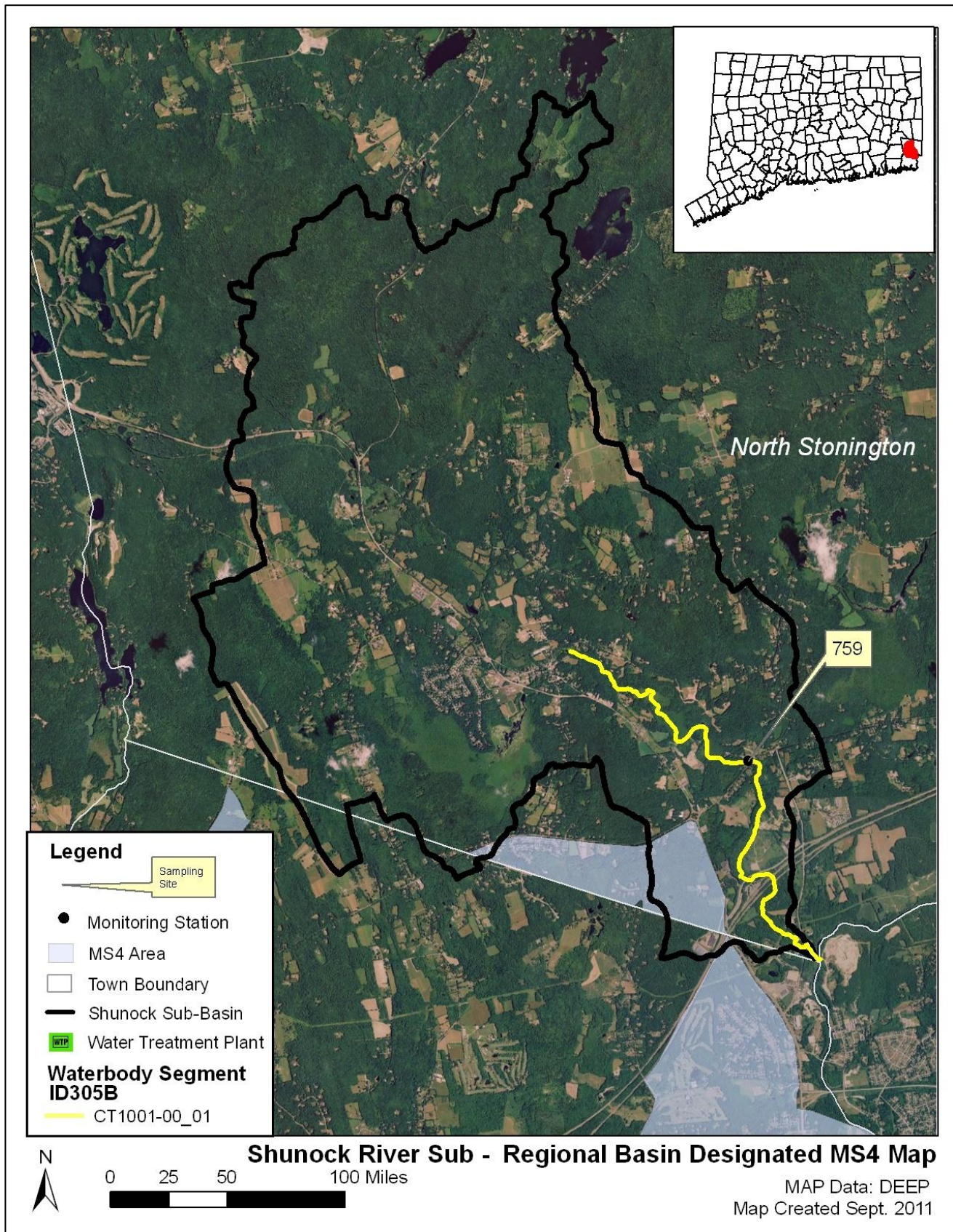
While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

The impaired segment of the Shunock River is located in the Town of North Stonington. As there are no urbanized locations, as defined by the U.S. Census Bureau, around the impaired segment, the town is not an MS4 area and is not required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the CT DEEP (Figure 7). Information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Figure 7: MS4 areas of the Shunock River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Shunock River watershed are described below.

Insufficient Septic Systems

As shown in Figure 6, there are no areas within the Shunock River watershed serviced by sanitary sewer. Households and businesses must rely on onsite wastewater treatment systems, such as septic systems. A large septic tank and leach field was identified adjacent to the headwaters of the Shunock River to the south of Route 201 in North Stonington (Figure 6). There may be additional undetected failed septic systems in the watershed. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Town of North Stonington has its own health department (http://www.northstoningtonct.gov/Pages/NStoningtonCT_Dept/Health/index) that handles insufficient or failing septic systems in the town.

Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up 12% of the Shunock River watershed. There are agricultural lands adjacent to the impaired segment of the Shunock River and its tributaries, particularly along Pendleton Hill Road and Route 2 in North Stonington. A large farm with 1-500 cattle is located on a tributary to the Shunock River off Chester Main Road (Figure 6). Agricultural areas near the impaired segment and its tributaries are potentially carrying pollutants, including bacteria, into the Shunock River.

Stormwater Runoff from Developed Areas

While the majority of the Shunock River watershed is forested and undeveloped, there are several developed areas that in proximity to the impaired segment. Approximately 15% of the land use in the watershed is considered urban, and much of that area is concentrated around the impaired segment in the Town of North Stonington (Figure 4). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

A large portion (95%) of the Shunock River watershed is characterized by 0-6% impervious cover and 5% is characterized by 7-11% impervious cover (Figures 8 and 9). While Figure 9 displays a fairly low level of impervious cover in the watershed, significant impervious cover from commercial development can be seen along the Interstate 95 corridor, particularly as it crosses the Shunock River. Given the proximity of impervious surfaces to the Shunock River, stormwater is a potential source of bacterial contamination to the impaired segment.

Figure 8: Range of impervious cover (%) in the Shunock River watershed

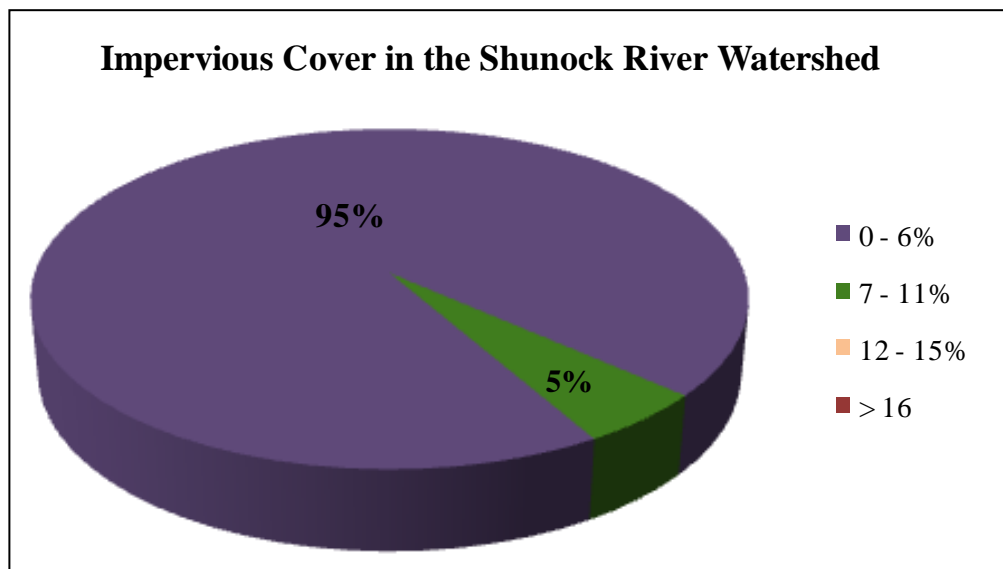
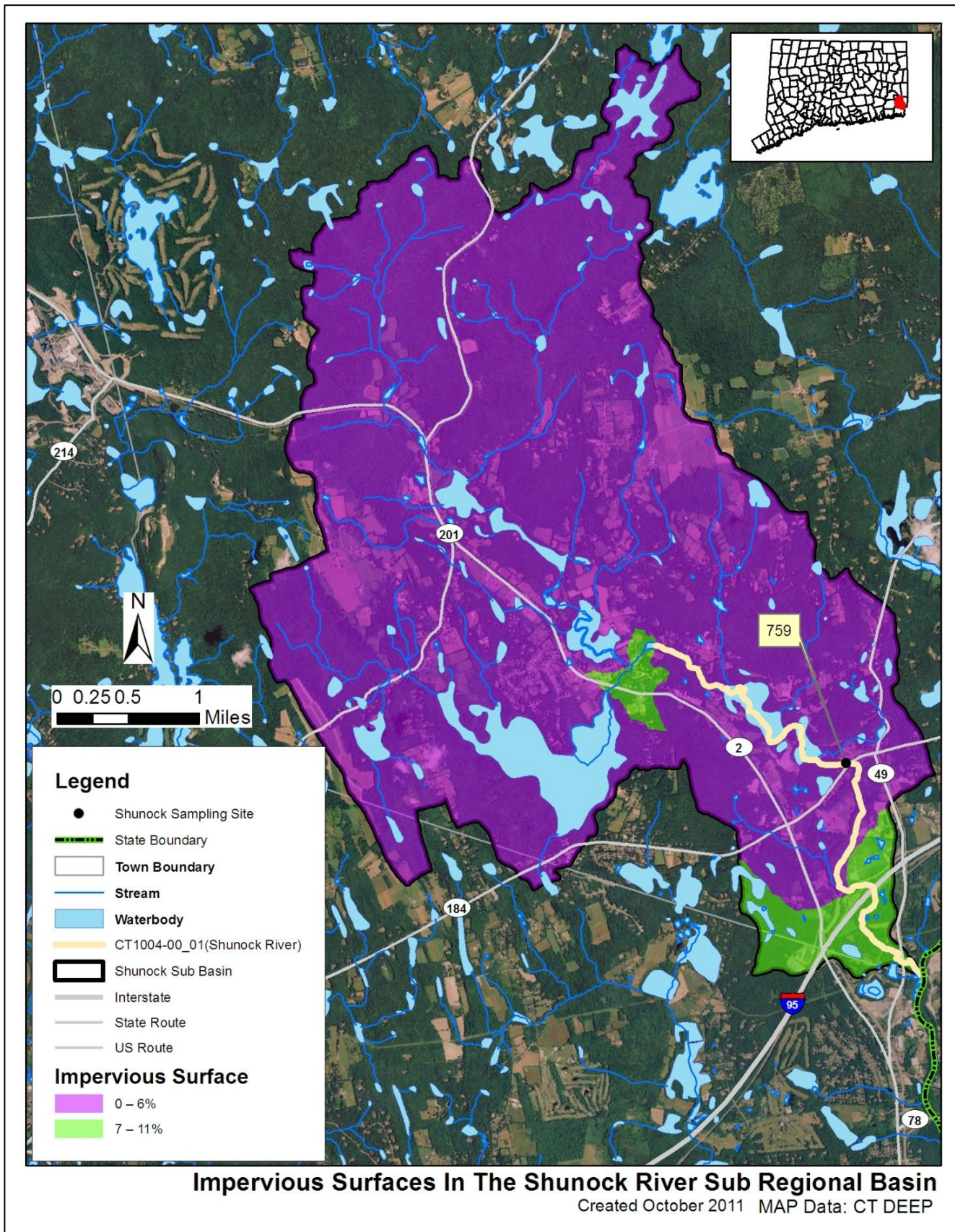


Figure 9: Impervious cover (%) for the Shunock River sub-regional watershed



Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Shunock River watershed represent another potential source of bacteria. With the construction of roads and drainage systems, wildlife wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas including recreational fields, golf courses, agricultural crop fields, and ponds. There are several recreational fields in proximity to the Shunock River, particularly at the Hewitt School off Route 2 in North Stonington, and the Wheeler Middle / High School on Route 2 and Main Street in North Stonington. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and ponds and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants. These factors make wildlife waste a potential source of bacteria to the Shunock River.

Also, residential development surrounds portions of the impaired segment of the Shunock River (Figure 4). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or through stormwater infrastructure. Therefore, domestic animal waste may also be contributing to bacteria concentrations in the Shunock River.

Additional Sources

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in the Shunock River. Further monitoring and investigation will confirm the listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

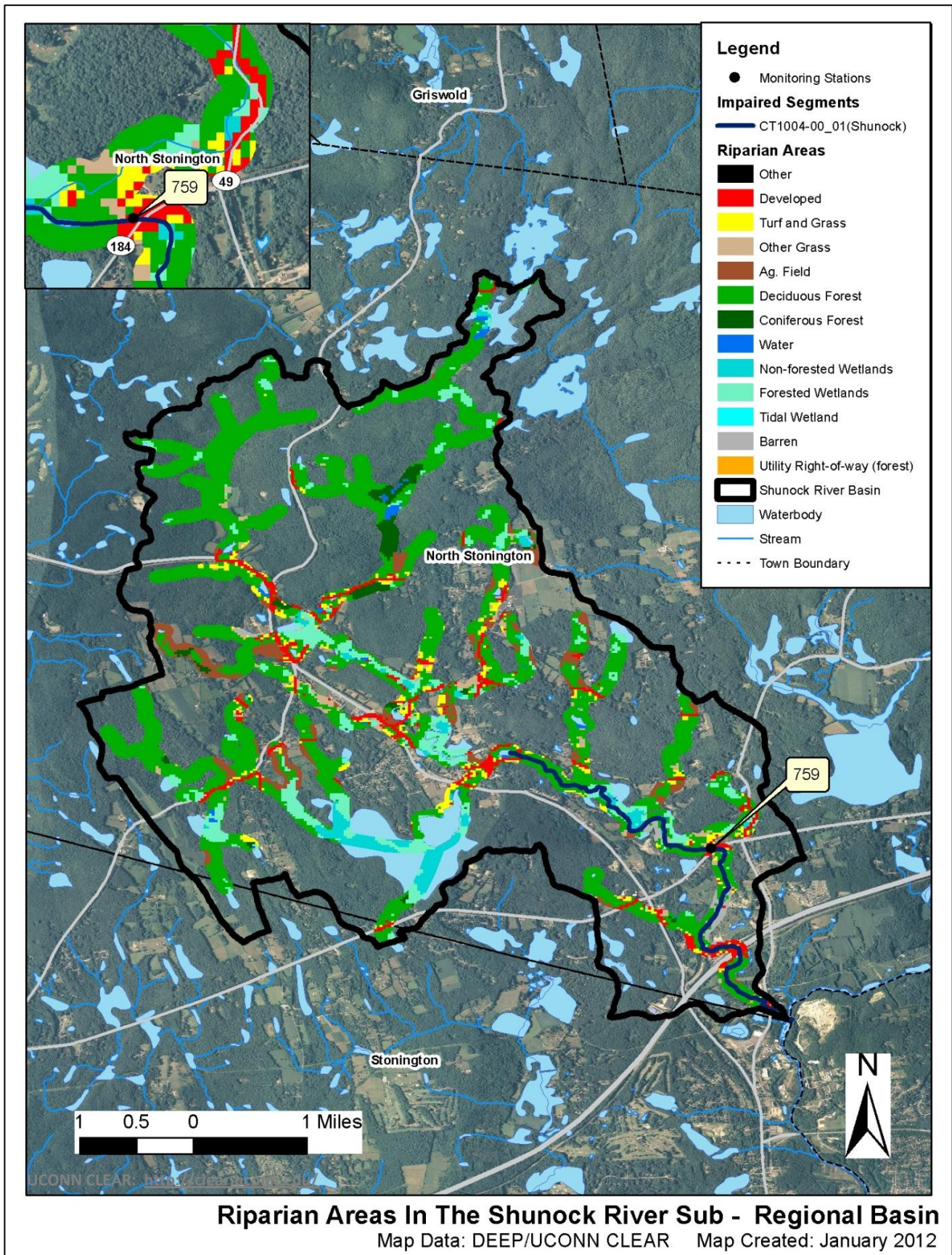
Land Use/Landscape***Riparian Buffer Zones***

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (<http://clear.uconn.edu/>), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The majority of the riparian zone for the impaired segment of the Shunock River is characterized by forested land use. However, there are several areas where development and agricultural land uses are found within the riparian zone of the Shunock River (Figure 10). As previously mentioned, developed and agricultural areas are potential sources of bacterial contamination.

Figure 10: Riparian buffer zone information for the Shunock River watershed



CURRENT MANAGEMENT ACTIVITIES

In 2008, the Eastern Connecticut Environmental Resource Conservation and Development Area, Inc. developed the Shunock River Non-Infringement Area Natural Resource Inventory. This report reviewed the Non-Infringement Area around the Shunock River, as defined by the North Stonington Planning and Zoning Commission (PZC). The PZC believed having a coherent plan for trails, water use, sewage disposal, and internal roads would help achieve the desired outcome of the Commercial Zone: a vibrant commercial zone with a river way as its centerpiece. The Non-Infringement Area around the river is located just upstream of the Interstate 95 crossing in North Stonington, along the impaired segment. While this document only addresses this small area around the Shunock River within the commercial zone, it represents a collaborative approach to protecting water quality within the Shunock River. The document is available online (below) and makes some recommendations to help manage bacterial pollution to the Shunock River's impaired segment. See the Shunock River Non-Infringement Area Natural Resource Inventory online at:

http://www.ctert.org/ERTWebsite/pdfs/NorthStonington_ShunockRiver_614.pdf

RECOMMENDED NEXT STEPS

As shown above, the Town of North Stonington has developed and implemented a program to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the impaired segment of the Shunock River and have been prioritized below.

1) Develop a system to monitor septic systems.

All residents in the watershed rely on septic systems (Figure 6). If not already in place, North Stonington should establish a program to ensure that existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could also be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

2) Ensure there are sufficient buffers on agricultural lands along the Shunock River.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to those agricultural operations located along the impaired segment and its tributaries.

3) Identify areas along the Shunock River to implement Best Management Practices (BMPs) to control stormwater runoff.

Since 15% of the watershed is considered urban and developed areas are located near the impaired segment, stormwater runoff is likely contributing bacteria to the waterbody. To identify specific areas that are contributing bacteria to the impaired segment, the towns should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Shunock River. To treat stormwater runoff, the town should also identify areas along the more developed sections of the Shunock River, particularly along the impaired segment, to install BMPs that encourage stormwater to infiltrate into the ground before entering the Shunock River. These BMPs would disconnect impervious areas and reduce pollutant loads to the

river. The Shunock River Non-Infringement Area Natural Resource Inventory (see link above) made several recommendations to address stormwater pollution in the Shunock River near the commercial zone.

1. Long term management and maintenance is key to ensuring that stormwater BMPs continue to function. Therefore, a management plan should be submitted by any development proposed in the commercial zone.
2. Routine inspections by the Town will ensure proper stormwater management and maintenance.
3. BMPs such as porous pavement, green roofs, and harvesting roof water for irrigation should be considered in new developments to reduce runoff volumes.
4. The Town should have individual development plans reviewed by a stormwater management professional to ensure all design and maintenance aspects have been addressed.

More detailed information and BMP recommendations can be found in the core TMDL document.

4) Evaluate municipal education and outreach programs regarding animal waste.

North Stonington can take measures to minimize waterfowl-related impacts such as encouraging residents and businesses to allow tall, coarse vegetation to grow in the riparian areas of the impaired segment of the Shunock River that are frequented by waterfowl, particularly within parks and golf courses. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shoreline will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans may contribute to water quality impairments in the Shunock River watershed and can harm human health and the environment. Animal wastes should be disposed of away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

5) Continue monitoring permitted sources.

Previous sampling of discharge from the Town of North Stonington has shown elevated levels of fecal coliform bacteria, an indicator of bacterial pollution (Table 6). Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 7 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Shunock watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 7. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

| | | Instantaneous <i>E. coli</i> (#/100mL) | | | | | | Geometric Mean <i>E. coli</i> (#/100mL) | |
|-------|--|--|------------------|------------------|------------------|------------------|------------------|---|------------------|
| Class | Bacteria Source | WLA ⁶ | | | LA ⁶ | | | WLA ⁶ | LA ⁶ |
| | Recreational Use | 1 | 2 | 3 | 1 | 2 | 3 | All | All |
| A | Non-Stormwater NPDES | 0 | 0 | 0 | | | | 0 | |
| | CSOs | 0 | 0 | 0 | | | | 0 | |
| | SSOs | 0 | 0 | 0 | | | | 0 | |
| | Illicit sewer connection | 0 | 0 | 0 | | | | 0 | |
| | Leaking sewer lines | 0 | 0 | 0 | | | | 0 | |
| | Stormwater (MS4s) | 235 ⁷ | 410 ⁷ | 576 ⁷ | | | | 126 ⁷ | |
| | Stormwater (non-MS4) | | | | 235 ⁷ | 410 ⁷ | 576 ⁷ | | 126 ⁷ |
| | Wildlife direct discharge | | | | 235 ⁷ | 410 ⁷ | 576 ⁷ | | 126 ⁷ |
| | Human or domestic animal direct discharge ⁵ | | | | 235 | 410 | 576 | | 126 |

- (1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.
- (2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.
- (3) **All Other Recreational Uses.**
- (4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)
- (5) Human direct discharge = swimmers
- (6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations
- (7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL**Table 8: Shunock River Bacteria Data****Waterbody ID:** CT1004-00_01**Characteristics:** Freshwater, Class A, Existing or Proposed Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:

Geometric Mean: NA

Single Sample: 86%

Data: 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* (colonies/100 mL) data from Station 759 on the Shunock River with annual geometric means calculated**

| Station Name | Station Location | Date | Result | Wet/Dry | Geomean |
|--------------|------------------|-----------|--------|---------|---------|
| 759 | Route 184 | 6/21/2006 | 41 | dry | 46 |
| 759 | Route 184 | 6/28/2006 | 50 | dry | |
| 759 | Route 184 | 7/3/2006 | 41 | dry | |
| 759 | Route 184 | 7/11/2006 | 41 | dry | |
| 759 | Route 184 | 7/18/2006 | 31 | dry | |
| 759 | Route 184 | 7/27/2006 | 52 | dry | |
| 759 | Route 184 | 8/2/2006 | 41 | dry | |
| 759 | Route 184 | 8/9/2006 | 63 | dry | |
| 759 | Route 184 | 8/16/2006 | 20 | wet | |
| 759 | Route 184 | 8/23/2006 | 180 | dry | |
| 759 | Route 184 | 9/11/2006 | 41 | dry | |

Single sample *E. coli* (colonies/100 mL) data from Station 759 on the Shunock River with annual geometric means calculated (continued)

| Station Name | Station Location | Date | Result | Wet/Dry | Geomean |
|--------------|------------------|-----------|------------------|---------|---------|
| 759 | Route 184 | 6/6/2007 | 170 | wet | 63 |
| 759 | Route 184 | 6/13/2007 | 20 | dry | |
| 759 | Route 184 | 6/20/2007 | 85 | dry | |
| 759 | Route 184 | 7/12/2007 | 31 | dry | |
| 759 | Route 184 | 7/19/2007 | 170 | wet | |
| 759 | Route 184 | 7/26/2007 | 41 | dry | |
| 759 | Route 184 | 8/9/2007 | 31 | wet | |
| 759 | Route 184 | 8/23/2007 | 52 | wet | |
| 759 | Route 184 | 9/4/2007 | 52 | dry | |
| 759 | Route 184 | 9/12/2007 | 200 | wet | |
| 759 | Route 184 | 6/4/2008 | 150 | wet** | 66* |
| 759 | Route 184 | 6/11/2008 | 41 [†] | dry** | |
| 759 | Route 184 | 6/19/2008 | 90 | dry** | |
| 759 | Route 184 | 6/25/2008 | 2900* | wet** | |
| 759 | Route 184 | 7/2/2008 | 96 | dry** | |
| 759 | Route 184 | 7/9/2008 | 10 | dry** | |
| 759 | Route 184 | 7/16/2008 | 10 | dry** | |
| 759 | Route 184 | 7/23/2008 | 10 | wet** | |
| 759 | Route 184 | 7/30/2008 | 31 | dry** | |
| 759 | Route 184 | 8/6/2008 | 945 [†] | wet** | |
| 759 | Route 184 | 8/13/2008 | 51 | dry** | |
| 759 | Route 184 | 8/21/2008 | 31 | dry** | |
| 759 | Route 184 | 6/3/2009 | 20 | dry** | 62 |
| 759 | Route 184 | 6/11/2009 | 30 | wet** | |
| 759 | Route 184 | 6/25/2009 | 52 | dry** | |
| 759 | Route 184 | 7/9/2009 | 250 | wet | |
| 759 | Route 184 | 7/16/2009 | 61 | dry | |
| 759 | Route 184 | 7/23/2009 | 41 | wet | |
| 759 | Route 184 | 7/29/2009 | 63 | dry | |
| 759 | Route 184 | 8/6/2009 | 52 | dry | |
| 759 | Route 184 | 8/13/2009 | 140 | dry | |
| 759 | Route 184 | 8/20/2009 | 97 | dry | |

Shaded cells indicate an exceedance of water quality criteria

[†] Average of two duplicate samples

** Weather conditions for selected data taken from Hartford because local station had missing data

*Indicates single sample and geometric mean values used to calculate the percent reduction

Wet and dry weather geometric mean values for Station 759 on the Shunock River

| Station Name | Station Location | Years Sampled | Number of Samples | | Geometric Mean | | |
|--|------------------|---------------|-------------------|-----|----------------|-----|-----|
| | | | Wet | Dry | All | Wet | Dry |
| 759 | Route 184 | 2006-2009 | 13 | 30 | 59 | 107 | 46 |
| Shaded cells indicate an exceedance of water quality criteria | | | | | | | |
| Weather condition determined from rain gage at Norwich Public Utility Plant in Norwich, CT | | | | | | | |

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